Laparoscopic vs Percutaneous Cryoablation for the Small Renal Mass: 15-Year Experience at a Single Center

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OBJECTIVE To analyze our 15-year experience with small renal masses ablation and present oncologic and functional outcomes of laparoscopic cryoablation (LCA) and percutaneous cryoablation (PCA).

MATERIALS AND METHODS We identified patients who underwent LCA (n = 275) or PCA (n = 137) for small renal masses between 1997 and 2012. Differences in overall survival (OS) and recurrence-free survival (RFS) were analyzed using a log-rank test. Cox proportional hazard ratios model was used to determine factors that predicted OS. Fit proportional hazard risk ratios were also calculated to determine if there were any factors that affected tumor recurrence.

RESULTS Tumor sizes were equal between the 2 groups; however, tumors in the PCA group were more complex. The overall (7.27% and 7.29%) and major complications (0.7% and 3.6%) were similar. The estimated probability of 5-year OS for LCA and PCA was 89% and 82%, respectively. The estimated probability of the 5-year RFS for LCA and PCA was 79% and 80%, respectively. Heart disease (hazard ratio, 2.15; 95% confidence interval, 1.35-3.41; *P* = .001) and history of disease recurrence (hazard ratio, 2.49; 95% confidence interval, 1.60-3.86; *P* = .001; *P* <.0001) were predictors of death. The median follow-up time for the LCA group (4.41 years [1.67-6.91 years]) was longer than the PCA group (3.15 years [1.37-4.08 years]; *P* = .0001).

CONCLUSION We found no significant difference in OS or RFS at 5 years between the 2 groups. Tumor size and anterior location affected local recurrence rates, and these factors should be taken into consideration when choosing the appropriate treatment plan. RENAL nephrometry score or type of cryoablation was not associated with tumor recurrence. UROLOGY 85: 850−855, 2015. © 2015 Elsevier Inc.

The incidence of malignant renal tumors, and specifically small renal masses (SRMs), has increased over the past 2 decades. According to the Surveillance, Epidemiology, and End Results database,[1] the incidence of SRMs has nearly tripled, likely due to the widespread use and refinement of cross-sectional imaging. Additionally, SRMs make up roughly 70% of new kidney tumor diagnoses.[2] These factors have led to the development of effective nephron-sparing treatment modalities. Open partial nephrectomy, and more recently laparoscopic or robotic-assisted partial nephrectomy, has shown equivalent oncologic outcomes when compared with radical extirpative surgery.[3,4] Thermal ablative therapies (radiofrequency ablation [RFA] and cryoablation [CA]) have emerged as alternative nephron-sparing treatment modalities for select patients. Short-term oncologic outcomes have approached those of partial nephrectomy in some series, albeit with higher recurrence rates and need for retreatment. However, it must be noted that the short duration of follow-up and selection biases may confound these results. Additionally, there are no prospective randomized studies, and long-term survival data from retrospective analyses are beginning to mature.

CA has been performed both laparoscopically and percutaneously. Theoretical advantages of the laparoscopic approach include placement of probes under direct visualization, and treatment of anterior tumors. Benefits of the percutaneous approach include the avoidance of a general anesthetic, shorter recovery time, and the ability for the procedure to be performed on an outpatient basis. There are few series comparing the 2 modalities, and most have focused on recovery time, postoperative pain, procedure time, and cost,[5-7] rather than oncologic and functional outcomes. Additionally, there are few series reporting intermediate survival data. We have had

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experience with both treatment modalities at our center, and we present our retrospective comparative analysis with intermediate oncologic outcomes.

MATERIALS AND METHODS

We retrospectively analyzed the electronic medical records of 436 patients who underwent either percutaneous CA or laparoscopic CA for an enhancing renal mass from October 1997 to July 2012. We excluded patients who had ablation for a recurrence after prior extirpative therapy. Data for patients meeting our criteria were collected in our institution review board–approved renal mass ablation database. Patient demographics (age, gender, body mass index [BMI], American Society of Anesthesiologists score, comorbidities, baseline renal function), tumor characteristics (clinical maximum tumor diameter, RENAL nephrometry score and its components), pathology findings of renal mass biopsy, presence of complications, and long-term functional outcomes were assessed for the patients. Patients who did not present for routine follow-up were contacted by the research team by telephone to determine survival at the time of the study.

Percutaneous Cryoablation

The lesion is first localized with a computed tomography (CT) scan, and then, an Fine Needle Aspiration biopsy is obtained and sent to pathology for analysis. The 2.4-mm cryoprobes (Endocare, Irvine, CA) are then inserted into the mass with CT guidance under moderate sedation and local anesthetic. Two cycles of CA are then typically performed, with the first cycle lasting 10 minutes, and the second lasting 8 minutes. Passive thaw is performed between cycles, and active thaw is performed after the second cycle. The size of the ice ball is monitored with a CT scan during the first cycle, and the target is 5-10 mm past the edge of the tumor. Thermocouples in the probe assembly monitor ablation site temperature. A CT is performed at the end of the procedure once the probes are removed to check for a hematoma.

Laparoscopic Cryoablation

Our technique for laparoscopic CA (LCA) has been previously described.[8] Briefly, the patient is placed in the flank position and access to the peritoneal cavity is gained in a standard fashion. The colon is reflected medially in typical fashion to expose the kidney. The tumor location is confirmed by intraoperative ultrasound, and a Tru-Cut (Medline Industries, Inc, Mundelein, IL) needle biopsy is then performed. One or more probes are then inserted into the tumor, and freezing is started. After 2 freeze cycles, the probe is removed, and the ablation zone is monitored for subsequent hemorrhage. Post-thaw hemostasis is obtained by using argon-beam coagulation and/or applying hemostatic agents, such as Floseal (Baxter Healthcare SA, Zurich, Switzerland), and Surgicel (Ethicon, Somerville, NJ).

Follow-up and Outcome Measures

A similar follow-up protocol was used for both laparoscopic and percutaneous cryotherapy patients. A CT scan or magnetic resonance imaging of the abdomen was performed at postoperative day 1 (usually without contrast) and 3, 6, 12, and 24 months after the date of surgery. Follow-up, after this, was at the discretion of the attending physician and was variable. Enhancement on initial follow-up imaging (3 months) was considered incomplete treatment, and enhancement after initial negative follow-up imaging or a positive biopsy at 6 months was considered a recurrence. Renal functional outcomes were assessed with serum creatinine measurements and a calculated estimated glomerular filtration rate (eGFR; using the Modification of Diet in Renal Disease equation).

Analysis

Renal function was assessed by eGFR calculated using the modification of diet in renal disease formula. Renal function preservation was defined as a percentage ratio of postoperative eGFR to preoperative eGFR. Complications were graded using the Clavien grading system. For continuous data with normal distribution, variables were presented as mean ± standard deviation. The mean values were compared using the Student *t* test. For variables with non-normal distribution, data were presented as median (interquartile range), and the groups are compared using nonparametric analysis (the Mann-Whitney *U* test). Categorical variables were compared using the chi-square test.

Kaplan-Meier survival curves were generated for both LCA and percutaneous CA (PCA) groups. Differences in overall survival (OS) and disease recurrence-free survival (RFS) were analyzed using a log-rank test. The Cox proportional hazard ratios model was used to determine factors that predicted OS. All tests were 2 sided, with $P < .05$ considered as statistically significant. Univariate and multivariate analyses were used to assess factors predicting local tumor recurrence. Factors with *P* value <.2 on univariate analysis were included in the multivariate analysis. Modality of CA was included in both univariate and multivariate analyses.

RESULTS

Four hundred twelve patients were included in the analysis. A total of 275 patients underwent LCA, whereas 137 patients underwent PCA. At baseline, the 2 groups were comparable for age, proportions of male gender, and renal function assessed by eGFR (Table 1). With regard to comorbidities, higher proportions of patients in the PCA group had the diagnosis of pre-existing heart disease, diabetes, hypertension, and von Hippel-Lindau syndrome. Additionally, there were a higher proportion of patients in the PCA group with a solitary kidney (25.5% vs 18.5%), but this was not statistically significant ($P = .09$). There was no significant difference in median tumor size between the 2 groups; however, the tumors treated in the PCA group had higher median RENAL nephrometry scores (7 vs 5; $P = .0001$), and higher proportions were at the posterior location (69% vs 23.1%; $P = .0001$; Table 1).

Complications

All procedures were completed successfully except for 1 PCA that had to be stopped because of biliary emesis. The rate of overall complications (7.27% and 7.29%; $P = 1$) and major complications (0.7% and 3.6%; $P = .1$) was similar between the PCA and LCA groups (Table 2).

Functional Outcomes

There was no significant difference in median eGFR preservation between LCA (88.55 mL/min/1.73 m^2